



INVESTIGATOR'S ANNUAL REPORT

United States Department of the Interior
National Park Service

All or some of the information you provide may become available to the public.

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Reporting Year: 2007	Park: Shenandoah NP	Select the type of permit this report addresses: Scientific Study	
Name of principal investigator or responsible official: Ken Hyer		Office Phone: 8042612636	
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Additional investigators or key field assistants (first name, last name, office phone, office email) No co-investigators			
Project Title (maximum 300 characters): The Effects of Human Activities and Recreational Use on the Bacteria Concentrations in the Streams of Shenandoah National Park, Virginia			
Park-assigned Study or Activity #: SHEN-00309	Park-assigned Permit #: SHEN-2005-SCI-0002	Permit Start Date: Apr 01, 2005	Permit Expiration Date: Sep 30, 2007
Scientific Study Starting Date: Apr 01, 2005		Estimated Scientific Study Ending Date: Sep 30, 2007	
For either a Scientific Study or a Science Education Activity, the status is: Completed		For a Scientific Study that is completed, please check each of the following that applies: <input checked="" type="checkbox"/> A final report has been provided to the park or will be provided to the park within the next two years <input type="checkbox"/> Copies of field notes, data files, photos, or other study records, as agreed, have been provided to the park <input type="checkbox"/> All collected and retained specimens have been cataloged into the NPS catalog system and NPS has processed loan agreements as needed	
Activity Type: Research			
Subject/Discipline: Water Quality			

Purpose of Scientific Study or Science Education Activity during the reporting year (maximum 4000 characters):

Fecal contamination of streams has resulted in elevated bacteria concentrations and has become a problem of national scope. Because of these elevated bacteria concentrations, State Regulatory Agencies have classified many surface waters as impaired with respect to bacterial water-quality standards. Elevated bacteria concentrations have been linked to human-influenced contributions like agriculture and urbanization (Hagedorn and others, 1999; Wiggins, 1996), as well as nonhuman-influenced contributions, such as wildlife (Simmons and others, 1995). Despite the widespread evaluation and characterization of bacteria concentrations in many impaired stream environments, minimal research has been directed towards recreational forested systems, like those found in national parks.

With approximately 1.8 million visitors each year (Shane Spitzer, Shenandoah National Park, written Communication, 2003), Shenandoah National Park is subject to extensive recreational use (including camping, hiking, swimming, and fishing). The effects of these park visitors and their associated recreational activities on the bacterial water quality of the streams in the park are largely unknown and a real concern for park managers. In one of the few published studies that have evaluated the bacterial water-quality

impact of human activities in national parks, Farag and others (2001) documented the occurrence of human fecal contamination â presumably caused by hikers and campers. Their work suggests that recreational use by visitors may adversely impact stream-water quality. Additional studies are needed to further understand these possible impacts. Because of its large number of recreational visitors each year, there is concern that some streams in Shenandoah National Park may have elevated bacterial levels. If elevated bacteria levels occur, they may pose a health risk to park visitors who come into contact with the streams.

The primary objective of this study is to measure bacteria concentrations in 14 streams in the park and determine the potential for human activities and recreational uses to adversely affect these concentrations. These data will also provide the park staff with an important initial database for managing water quality and assessing possible risks to human health.

Findings and status of Scientific Study or accomplishments of Science Education Activity during the reporting year (maximum 4000 characters):

Project is completed. The report is available at:

<http://pubs.usgs.gov/sir/2007/5160/>

The report abstract is pasted below.

Although fecal contamination of streams is a problem of national scope, few investigations have been directed at relatively pristine streams in forested basins in national parks. With approximately 1.8 million visitors annually, Shenandoah National Park in Virginia is subject to extensive recreational use. The effects of these visitors and their recreational activities on fecal indicator bacteria levels in the streams are poorly understood and of concern for Shenandoah National Park managers.

During 2005 and 2006, streams and springs in Shenandoah National Park were sampled for Escherichia coli (E. coli) concentrations. The first study objective was to evaluate the effects of recreational activities on E. coli concentrations in selected streams. Of the 20 streams that were selected, 14 were in basins with extensive recreational activity, and 6 were in control basins where minimal recreational activities occurred. Water-quality sampling was conducted during low-flow conditions during the relatively warm months, as this is when outdoor recreation and bacterial survivorship are greatest. Although most sampling was conducted during low-flow conditions, approximately three stormflow samples were collected from each stream. The second study objective was to evaluate E. coli levels in backcountry drinking-water supplies throughout Shenandoah National Park. Nineteen drinking-water supplies (springs and streams) were sampled two to six times each by Shenandoah National Park staff and analyzed by the U.S. Geological Survey for this purpose.

The water-quality sampling results indicated relatively low E. coli concentrations during low-flow conditions, and no statistically significant increase in E. coli concentrations was observed in the recreational streams relative to the control streams. These results indicate that during low-flow conditions, recreational activities had no significant effect on E. coli concentrations. During stormflow conditions, E. coli concentrations increased by nearly a factor of 10 in both basin types, and the Virginia instantaneous water-quality standard for E. coli (235 col/100 mL) frequently was exceeded.

The sampling results from drinking-water supplies throughout Shenandoah National Park indicated relatively low E. coli concentrations in all springs that were sampled. Several of the streams that were sampled had slightly higher E. coli concentrations relative to the springs, but no E. coli concentrations exceeded the instantaneous water-quality standard. Although E. coli concentrations in all the drinking-water supplies were relatively low, Shenandoah National Park management continues to stress that all hikers must treat drinking water from all streams and springs prior to consumption.

After determining that recreational activities in Shenandoah National Park did not have a statistically significant effect on low-flow E. coli concentrations, an additional concern was addressed regarding the quality of the water releases from the wastewater-treatment plants in the park. Sampling of three wastewater-treatment plant outfalls was conducted in 2006 to evaluate their effects on water quality. Samples were analyzed for E. coli and a collection of wastewater organic compounds that may be endocrine disruptors. Relatively elevated E. coli concentrations were observed in two of the three samples, and between 9 and 13 wastewater organic compounds were detected in the samples, including 3 known and 5 suspected endocrine-disrupting compounds.

For Scientific Studies (not Science Education Activities), were any specimens collected and removed from the park but not destroyed during analysis?

No

Funding specifically used in this park this reporting year that was provided by NPS (enter dollar amount):
\$0

Funding specifically used in this park this reporting year that was provided by all other sources (enter dollar amount):
\$50000

List any other U.S. Government Agencies supporting this study or activity and the funding each provided this reporting year:

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